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AN ACANTHOSPORID GREGARINE FROM NORTH AMERICAN DRAGONFLY NYMPHS.

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In 1892 Leger[2] described six species of cephaline gregarines with spiny sporocysts, establishing a new family, the *Acanthosporidæ*. These gregarines possess epimerites of the type found on the Actinocephalid gregarines but differ from all cephaline gregarines in having prominent, rigid spines on the sporocysts. Subsequently two other species of Acanthosporids were described by Leger[3] in 1896. Wellmer[4] in 1912 found the species described by A. Schneider[5] as *Actinocephalus stelliformis,* to be a composite, one form of which is an Acanthosporid, redescribed as *Ancyrophora stelliformis* (A. Schneider). In all at least nine species of cephaline gregarines are known to have spiny sporocysts, and a tenth species has been referred to *Acanthosporidæ* on the basis of the epimerite, by Wellmer, l. c. All of these species are recorded thus far only from France and Prussia. During the past summer however an undescribed species of cephaline gregarine, taken from Odonata nymphs in northern Michigan, was found to be a typical Acanthosporid, representing a new genus with a peculiar combination of Acanthosporid characters.

[1]Contribution from the Uni. Mich. Biol. Station, No. 29.
[2]Tabl. zool., III, pp. 144 et seq.
[3]Ann. Fac. Marseille, VI, pp. 42-44.
[4]Schr. Phys. Okon. Gesellschaft Königsberg, p. 137.
[5]Arch. Zool. exper., IV, p. 588.

Prismatospora genus nov.

Type—*Prismatospora evansi* sp. nov.

Sporocyst prismatic, composed of a central, regular hexagonal prism capped at each end by a regular, truncated, hexagonal pryamid; spines of the sporocyst long, in two series of six each, inserted symmetrically in the tetrahedral angles at the junctions of the apical pyramids with the central prism; no equatorial or polar spines; epimerite subglobose with lateral, recurved hooks.

The genus *Prismatospora* stands close to the genus *Cometoides* Labbe. The relationships of the genera of *Acanthosporidæ* are shown in the following table, which gives the different combinations of generic characters.

TABLE I

	Prisma-tospora	Come-toides	Ancyro-phora	Acantho-spora	Corycella
Sporocysts circular in cross section					x
Sporocysts polygonal in cross section	x	x	x	x	
Sporocysts with one row of equatorial spines			x	x	
Sporocysts with polar spines		x	x		x
Sporocysts with two series of subpolar, lateral spines	x	x			
Epimerite with lateral recurved hooks	x		x	x	x

Prismatospora evansi sp. nov.[6]

Taken from nymphs of the dragonflies, *Tramea lacerata* Hagen and *Sympetrum rubicundulum* Say, of the family *Libellulidæ*, collected in Bryant's Bog and Smith's Bog, Douglas Lake, Michigan, during July and August, 1914.

Sporonts, when relaxed, broadly conical, tapering posteriorly; length of the protomerite about one-third of the total length; protomerite ovoid to subglobose, its width usually a little greater than, although often equal

[6]To Mr. Arthur T. Evans who collected the first lot of nymphs from which this gregarine was taken and who aided in the study of this species in many ways.

to or even a little less than, the greatest width of the deutomerite; deutomerite rather regularly conical, broadly joined to the protomerite so that the greatest width of the deutomerite is usually at or a short distance posterior to the junction of the deutomerite with the protomerite; epicyte rather thick but very pliable over the entire animal, thickest along the sides of the protomerite; sarcocyte clear and easily visible over the entire gregarine; endocyte very dense in the deutomerite where it is composed of distinctly smaller granules than in the protomerite, less dense in the protomerite, a rich cream yellow by reflected light and opaque gray by transmitted light; nucleus obscured by the dense endocyte of the deutomerite in living specimens, but easily visible in the cleared ones, its diameter about one-fifth of the greatest width of the deutomerite; karyosomes large, numerous and conspicuous even in unstained specimens, strongly eosinophilic when stained, variable in size and number, the largest number seen in a single nucleus being 16; average sporonts 400μ in length, varying from 250μ to 500μ.

Cephalonts less conical and more ovoid than the sporonts, protomerite and deutomerite about the same size in small cephalonts, the deutomerite however becoming more pointed posteriorly and larger as the cephalont approaches the sporont stage; epimerite carried by an elongated portion of the protomerite, which pedicle consists of a basal hemispherical portion bearing a distal, inverted, hemispherical portion of about the same length but slightly narrower; epimerite proper broadly joined to the pedicle by a more or less globose central portion which bears eight recurved hooks; hooks of the epimerite arranged in four pairs at right angles to each other which form a regular cross when seen from the apical end on the epimerite; mesial, apical portion of the epimerite slightly elevated beyond the pairs of hooks; average, free cephalonts 100μ in length; epimerite 15μ long, circle hooks 10μ across.

Cysts rather regularly subspherical, covered by a thin, transparent, gelatinous capsule; internal sporal mass white to pale yellow by reflected light, usually showing an equatorial constriction when the cyst is first discharged from the host; maturation period seven to eight days (July, at room temperature and in distilled water); dehiscence by the simple rupture, violent, sporocysts well scattered, residual sporal mass not large; average cysts when fresh from the host about 370μ in diameter; measurements of three cysts which subsequently dehisced were:

Diameter of Sporal Mass	Thickness of Gelatinous Capsule	Total Diameter
320μ	33μ	386μ
242μ	110μ	462μ
220μ	44μ	308μ

Sporocysts prismatic and highly refractive; each composed of a central regularly hexagonal prism capped at each end by a regular, truncated hexagonal pyramid, and bearing a row of six spines at the junction of each cap with the central portion; spines long, almost equalling in length the long side of the sporocyst, symmetrically inserted in the tetrahedral angles; total length of the sporocyst 11μ, long side 7μ, width about 5.8μ; sporocysts kept in water for 10 days became more or less opalescence without a change in form.

The relations of *Prismatospora evansi* to the host were peculiar in several ways. The ventral abdominal wall of the nymph host is so thin and transparent that the gregarines were easily visible in the living host and could be studied in place with a binocular miscroscope.

The abdominal portion of the alimentary canal of the hosts in which *Prismatospora evansi* was found tapers from the first abdominal segment to the sixth or seventh segment, where it is narrowed to about one-half its diameter in the first segment. Posterior to segment 6 or 7 the alimentary canal expands abruptly into the rectal respiratory chamber. This chamber narrows slightly near the anus. Without exception the gregarines were found in the first division of the abdominal alimentary canal of the host and usually near the posterior constriction of this division, that is, in that part of the canal included in segments 4 and 5. The rectal portion of the alimentary canal is modified so that it functions as the chief respiratory organ of the dragonfly nymph and also aids in locomotion, since the recoil of the jets of water which are forcibly discharged from the rectum at intervals drive the animal forward. The violent contractions of the rectal region attendant to the discharge of water either for respiratory purposes or for locomotion affect the posterior portion of the abdominal alimentary canal to such an extent that it is often pushed forward a segment or two, dropping back in place after the contractions have been completed. This continuous change of water in the rectal region together with the violent contractions would easily dislodge any parasite in the rectal region not provided with some means of attachment, and the absence of gregarines from this region was to be expected. In this connection it may be noted that the rectal portion of the alimentary canal in all of the several hundred hosts examined was clean and free from debris of any sort, the dejecta being

promptly removed by the outbound currents of water on reaching this portion of the alimentary tract. It is very probable therefore, that the cysts of *Prismatospora evansi* do not complete maturation in the body of the host.

By marking the exact location of numerous gregarines in the anterior or prerectal portion of the abdominal alimentary canal it was found that the sporonts of this species move very little if at all once they have established themselves in a suitable position on the wall of the alimentary canal. During a series of observations extending over ten days 37 gegarines were examined in place daily and their positions recorded, and the greatest distance covered

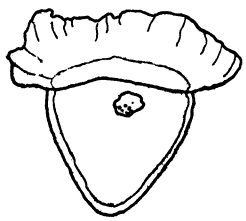

Fig. 1.

Fig. 1. Sporont of *Prismatospora evansi* with the protomerite flattened against the wall of the alimentary canal of the host.

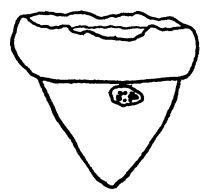

Fig. 2.

Fig. 2. Sporont with the protomerite cupped to include a portion of the alimentary canal wall.

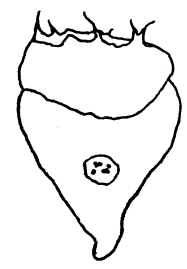

Fig. 3.

Fig. 3. Sporont showing processes from the protomerite extending into the irregularities of the wall of the intestine.

during this ten days by any single gregarine was found to be but one-half of a millimetre. Twenty-nine of the sporonts observed did not move at all during this time, showing that these gregarines are not disturbed by the sudden and violent contractions of the rectal region which often crowd the alimentary canal forward. With a view to determining the relation of the activity of these gregarines to the condition of the alimentary canal of the host 20 dragonfly nymphs were isolated in separate dishes containing nothing but distilled water, and at the same time 20 others from the same catch were placed in separate dishes containing lake water, vegetation and plankton. The nymphs in distilled water were starv-

ed for a period of ten days during which time the alimentary canal of every individual was almost entirely emptied of debris. No change of position was observed for any of the 42 gregarines carried by the hosts in the two series.

The explanation of this fixity of position of the sporonts was obtained from sections of the alimentary canal of the host which had been killed with the gregarines in place, supplemented by teased preparations. The anterior end of the protomerite of a sporont is very plastic and may be cupped into a concave disk resembling the sucking-disk of a trematode. The margin of this concave portion of protomerite is very irregular, showing numerous crenulations which fit into the irregularities of the host's alimentary canal. These crenulations are not permanent structures as may be seen from

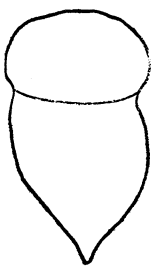

Fig. 4.

Fig. 4. Outline of a sporont after treatment with distilled water, showing the rounded condition of the protomerite.

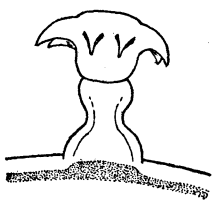

Fig. 5.

Fig. 5. Epimerite and pedicle of the epimerite.

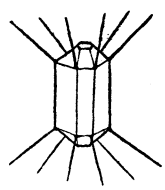

Fig. 6.

Fig. 6. Sporocyst of *Prismatospora evansi.*

figures 1, 2 and 3, but are pushed out like pseudopodia to fit the particular inequalities of the portion of the alimentary canal to which the sporont is attached. When removed from the alimentary canal and placed in some passive fluid as Ringer's solution or physiological salt solution the living gregarines expand this concave portion of the protomerite assuming a form like that shown in figure 4. When placed in distilled water this change in form was sudden and was usually accompanied by a concentration of the endosarc near the center of the gregarine. By a comparison of specimens of this gregarine killed in place, with living, unattached indi-

viduals it was thought that the cupping of the protomerite was accomplished by a lateral expansion of the protomerite and a synchronous shortening of this part for the protomerites of individuals in place in the alimentary canal were always shorter and broader than those of free, unattached individuals. No gregarine was observed in the process of attachment.

A possible explanation of this attachment habit of *Prismatospora evansi* may be found in the reduction of the chances of the dislodgement of the gregarine and its subsequent discharge from the host during one of the rectal contractions if it be provided with some means of attachment to the wall of the alimentary canal. Again there is a possibility that food may be absorbed through the crenulations of the protomerite, although no evidence of degeneration in any of the cells included by the crenulations of a protomerite, was found.

Fig. 7.

Fig. 7. Diagram of the cross-section of the ectosarc of a cephalont, showing the papillæ and the finger-like processes.

The infection of the host species was general in the region about Douglas Lake, Michigan, about 90% of all host nymphs examined having ten or more of the sporonts of *Prismatospora evansi* in the anterior portion of the abdominal alimentary canal. Twenty gregarines or more were often crowded into that part of the alimentary canal in segments 4 and 5 visible from the outside. Although very little work was done on the injuries to the host caused by this gregarine such data as were collected in connection with moulting of the host, ability to swim and feeding habits suggested that the host suffers very little inconvenience from the presence of this parasite.

Aside from the discussion of the morphology of *Prismatospora evansi* given in the description of this species one other point deserves mention. The ectosarc of all cephalonts examined had a "woolly" appearance when seen with the low power. Under oil immersion sections of the ectosarc showed this layer to be thickened rather regularly into small papillæ and the entire surface of the

ectosarc to be covered with short, clear finger-like processes. The papillæ were usually less than one micron apart and the space between the papillæ bore ten or more of the finger-like processes. Neither the papillæ nor the finger-like processes were found on the sporonts. The function of these structures has not been determined.

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